

Klamath Irrigation Project Sucker Salvage and Langell Valley Fish Survey Report - 1999

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May 2, 2000

Key words: sucker, endangered fish, Klamath, canal salvage

The correct citation for this report is:

Peck, B. J. 2000. Klamath Irrigation Project sucker salvage and Langell Valley fish survey report - 1999. U.S. Bureau of Reclamation, Klamath Falls, Oregon. Annual report.

SUMMARY

This report presents data collected during 1999 from endangered sucker sampling and salvage operations. Work was performed from October 1 through November 23 at various locations within the Klamath Project (Project). A total of 17 different fish species were encountered. Target species included endangered Lost River suckers (*Deltistes luxatus*) and shortnose suckers (*Chasmistes brevirostris*), with non-listed Klamath largescale suckers (*Catostomus snyderi*) and redband trout (*Oncorhynchus mykiss*) also being collected. Data analysis focused on length frequency, age class structure, distribution, abundance and species composition.

A total of 27,001 suckers (233 shortnose, 31 Lost River, 281 Klamath largescale, 26,456 unknown) and approximately 690 redband trout were captured in all dam and canal salvage and sampling efforts conducted in 1999.

On October 1, 6 suckers (4 shortnose, 2 Lost River) were salvaged below Clear Lake Dam and relocated to the Lost River at Stevenson Park, Oregon. From October 4 - October 14, on 5 days, sampling was conducted on the North Canal in the Langell Valley Irrigation District (LVID). A total of 16 suckers (3 shortnose, 13 unknown) and 412 redband trout (estimated additional 250 redband trout) were captured and relocated to the Lost River one mile above Keller Bridge, Oregon. On October 7, 7 unknown suckers were captured from the West Canal of LVID and relocated to the Lost River one mile above Keller Bridge. No mortalities were observed during any of these operations.

On October 18 and 19, salvage was conducted below Link River Dam. A total of 44 suckers (7 shortnose, 4 Klamath largescale, 33 unknown) were collected and relocated to permanent water on the Link River. No sucker mortalities were observed during this salvage.

Fish were salvaged from Klamath Irrigation District (KID) canals between October 18 and November 12. A total of 23,806 suckers (219 shortnose, 29 Lost River, 277 Klamath largescale, 23,281 unknown) and 27 redband trout were captured and released to Upper Klamath Lake at Barkley Spring, Oregon. Sixty-one (0.3% of total) suckers (12 shortnose, 2 Lost River, 30 Klamath largescale, 17 unknown) and 8 redband trout (29.6% of total) died during KID salvage operations. Six of the redband trout that died during 1999 salvage were collected at site 1 on November 4. A large number (868 total suckers, including 111 greater than 240 mm fork length) were salvaged at this site on this date. Trout mortality was probably associated with stress from electrofishing and low dissolved oxygen levels in transport containers.

On November 22 and 23, salvage was conducted on Tulelake Irrigation District (TID) canals. A total of 3,122 unknown suckers and 1 redband trout were collected and relocated to the Lost River immediately downstream of Anderson-Rose Dam, Oregon. No sucker or trout mortalities were observed during TID salvage.

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INTRODUCTION

Reclamation conducted several fish salvage operations throughout the Project during 1999 to minimize take of endangered Lost River and shortnose suckers (Figure 1). This nondiscretionary activity was identified as a Reasonable and Prudent Alternative in the U.S. Fish and Wildlife Service's (Service) Biological Opinion (BO) on the long-term operation of the Klamath Project (USFWS, July 22, 1992). The BO requires Reclamation to conduct annual salvage of endangered suckers stranded in canal systems and below outlet structures of dams within the Project. The BO also requires that annual salvage will include eight sites that yielded more than 20 suckers (>80 mm in total length) in the 1991 canal salvage operation.

A salvage plan must be presented to the Service, Oregon Department of Fish and Wildlife (ODFW) and California Department of Fish and Game (CDFG) for their approval prior to any salvage operation. Reclamation submitted the 1999 salvage plan to the Service and state resource agencies for approval on January 21, 1999. Permits and/or response letters were received on September 30 from the Service, March 9 from ODFW, and on September 29 from CDFG (see Attachments). Also, the Service, ODFW and CDFG were verbally notified prior to commencing salvage activities. See the attached state and federal permits for additional details.

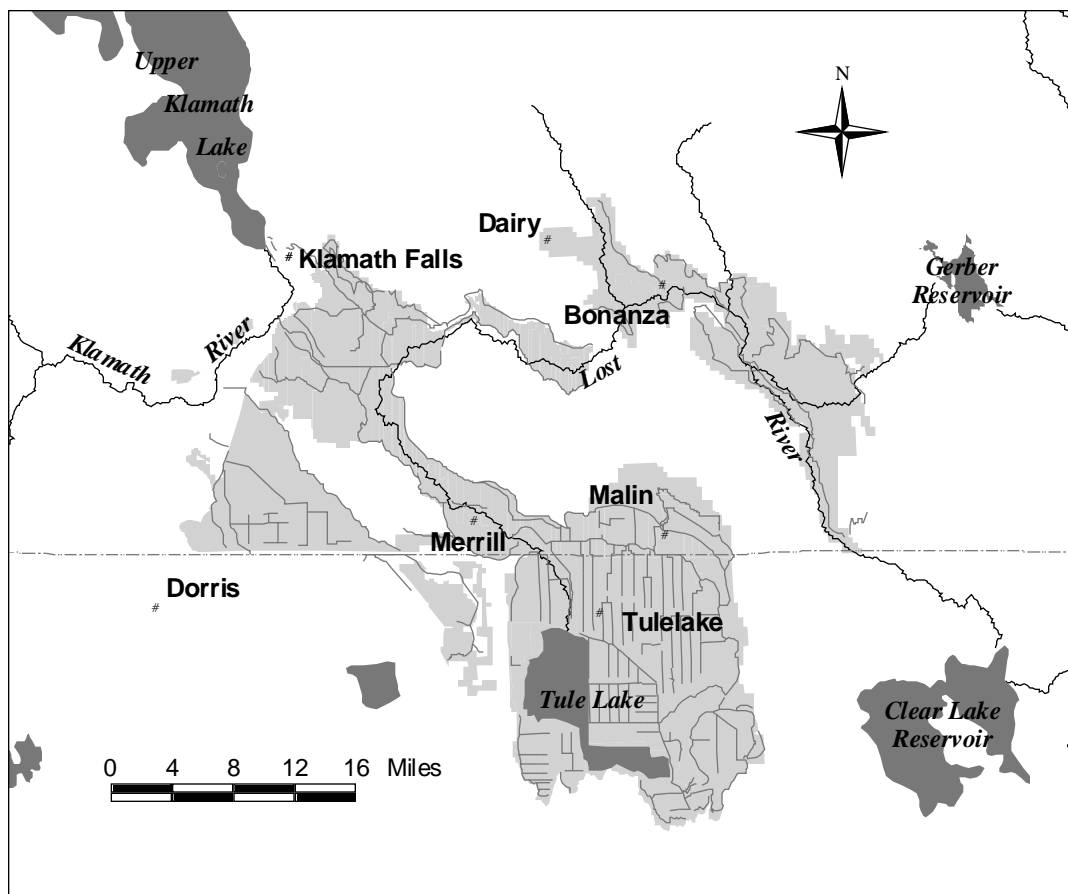


Figure 1. Klamath Project, U.S. Bureau of Reclamation, Oregon and California.

METHODS

Smith-Root model 15-B electrofishers with programmable output waveforms were used to remove fish from the canal system and dam outlets. Pulsed direct current was used with voltage set at 200-400 volts, pulse frequency at 50-60 Hz, and pulse width of 4-7 ms. Crew size ranged from two to eight people, with most sites requiring two electrofishers. Each site was entered on the downstream end and the crew worked slowly upstream. Sites with check structures or head gates were often dry or very shallow (<0.1 m) at the structure, thus preventing fish from swimming upstream. In some locations with deeper water (0.5 m, North Canal, Langell Valley), block nets were used to prevent fish from moving away from salvage activities.

Salvage operations began as soon as the water levels in the canals were drawn down. Effort was concentrated at pooled areas below drop structures, checks, bridges, and sites where most suckers were found during 1991-1998 salvage operations. Spot-checks were made in open canal sections adjacent to salvage sites. No suckers were captured in areas less than 0.3 m deep and devoid of structure. More than 90% (estimated) of the canals are shallow and lack structure.

Captured suckers and trout were immediately put into five-gallon buckets and held until salvage at the site was complete or the buckets reached capacity. The fish were then transferred to an oxygenated holding tank in the bed of a pickup truck on site. To reduce stress on fish, the tank was pre-treated with kiln dried salt (5 ppt, no additives) and a protective multilayered slime coating.

Depending on the quantity of salvaged fish, they were either measured before being transferred to the holding tank or were immediately put into the tank and measured before release. Collected data included: species, sex, fork length (mm), weight (g), passive integrated transponder (PIT) number, and comments on condition. Most suckers <200 mm fork length (FL) were difficult to identify to species and were classified as unknown. All suckers >240 mm were scanned for pre-existing PIT tags, and new tags were implanted ventrally into healthy suckers >300 mm and scanned for identification.

Since 1992, several procedures have been used at the end of the irrigation season to encourage suckers to move to permanent water (Lost River, Klamath River). Methods include: accelerated draw-down, flushing and use of bottom drains. These methods involve the rapid lowering of canal water to encourage fish to leave the canal. This was accomplished by adjusting the canal's check gates and spillways to direct flow into open drains leading to the Lost or Klamath rivers. Canals with bottom drains allow water to be more completely drained into permanent waters (Lost and Klamath rivers). These procedures have minimized the number of suckers needed to be salvaged.

Maintaining the canals free of debris and aquatic vegetation helps reduce the number of fish remaining in the canals during draw-down. This structure serves as cover for fish. Canals have also been modified in order to be more effectively drained. Based on nine years of salvage operations, suckers are rarely found in water depths less than 0.3 m. In the Tule Lake area almost all laterals drain completely except for small pools of water at headgates.

Collected fish were released at different locations, depending on the capture site. Fish sampled from the North and West Canal were released into the Lost River one mile above Keller bridge. Suckers salvaged below Clear Lake Dam were released into the Lost River at Stevenson Park. Fish salvaged from KID canals were released into Upper Klamath Lake at Barkley Spring. Fish salvaged from TID canals were released into the Lost River below Anderson-Rose Dam.

RESULTS and DISCUSSION

North Canal, Langell Valley Fish Survey

From October 4-14, on five days, personnel from Reclamation, LVID and the Bureau of Land Management (BLM) sampled the upper half of the 20 mile long canal using electrofishers, block nets and dip nets. The lower 10 miles of canal completely drained or was less than 0.3 m deep.

Prior to commencing salvage, LVID closed the gate at Gerber Dam, thereby stopping flow from the reservoir into Miller Creek. However, spring seeps maintain a small flow within Miller Creek. A gate at the head of the North Canal was also closed, preventing flow from entering the canal. LVID pulled check boards and opened spill gates to further draw-down water in the canal. Bottom topography of the canal prevented water from completely draining, leaving the upper 10 miles (approximate) of canal with water depths ranging from 0.0 - 1.2 m.

A total of 16 suckers (3 shortnose, 13 unknown), 412 redband trout and an unknown number of sculpin (*Cottus sp.*) and speckled dace (*Rhinichthys osculus*) were collected. Approximately 250 additional redband trout were captured, however the field book containing the data was lost. Species occurred in the following order of relative abundance, from higher to lower: redband trout, speckled dace, fathead minnow (*Pimephales promelas*), yellow perch (*Perca flavescens*), sculpin, unknown sucker, shortnose sucker, and lamprey (*Lampetra sp.*).

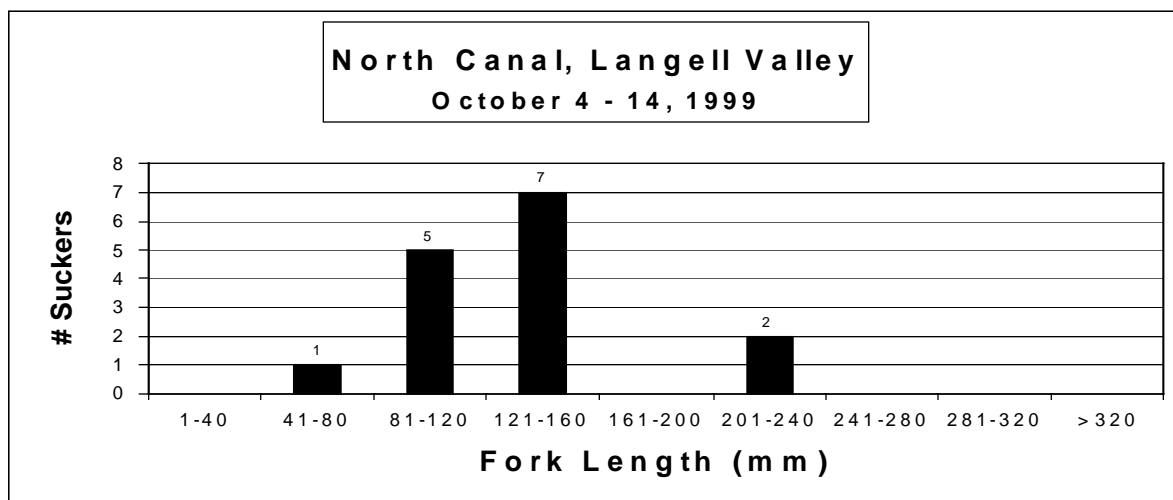


Figure 2. Length frequency of shortnose and unknown suckers measured from North Canal, Langell Valley, Oregon.

Suckers ranged in size from 72 - 215 mm FL, with a mean of 134 mm, and median of 130 mm (Figure 2). Six suckers (40%) less than 120 mm FL were probably young-of-the-year, representing the 1999 year class, seven suckers were from the 1998 year class and there were two older (209, 215 mm) shortnose suckers.

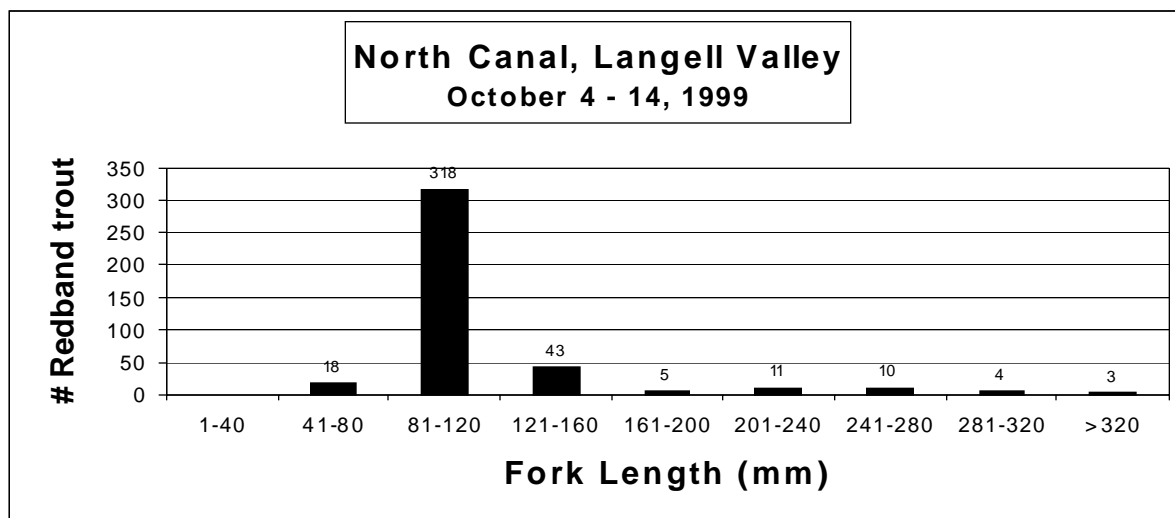


Figure 3. Length frequency of redband trout sampled from North Canal, Langell Valley, Oregon.

An estimated total of 662 redband trout were collected of which 412 were measured (Figure 3). Trout ranged from 70 - 387 mm FL, with a mean of 113 mm, and median of 101 mm. Three hundred and thirty six trout (82%) were probably young-of-the-year, representing the 1999 year class.

Salvaged fish originated from either Gerber Reservoir or Miller Creek. However, fish in Miller Creek may have migrated from the Lost River.

West Canal, Langell Valley Fish Survey

On October 7, fish sampling was conducted in the West Canal of Langell Valley. A total of seven unknown suckers were collected, ranging from 74 - 110 mm FL, with a mean of 90 mm, and a median of 87 mm (Figure 4). Species encountered included: brown bullhead (*Ictalurus nebulosus*), unknown bullhead, fathead minnow, largemouth bass, pumpkinseed sunfish (*Lepomis gibbosus*), Sacramento perch (*Archoplites interruptus*), yellow perch, blue chub, sculpin, and unknown sucker.

Numerous juvenile and adult largemouth bass were encountered during sampling. The five largest ranged from 278 - 353 mm FL, with a mean of 311 mm, and a median of 308 mm.

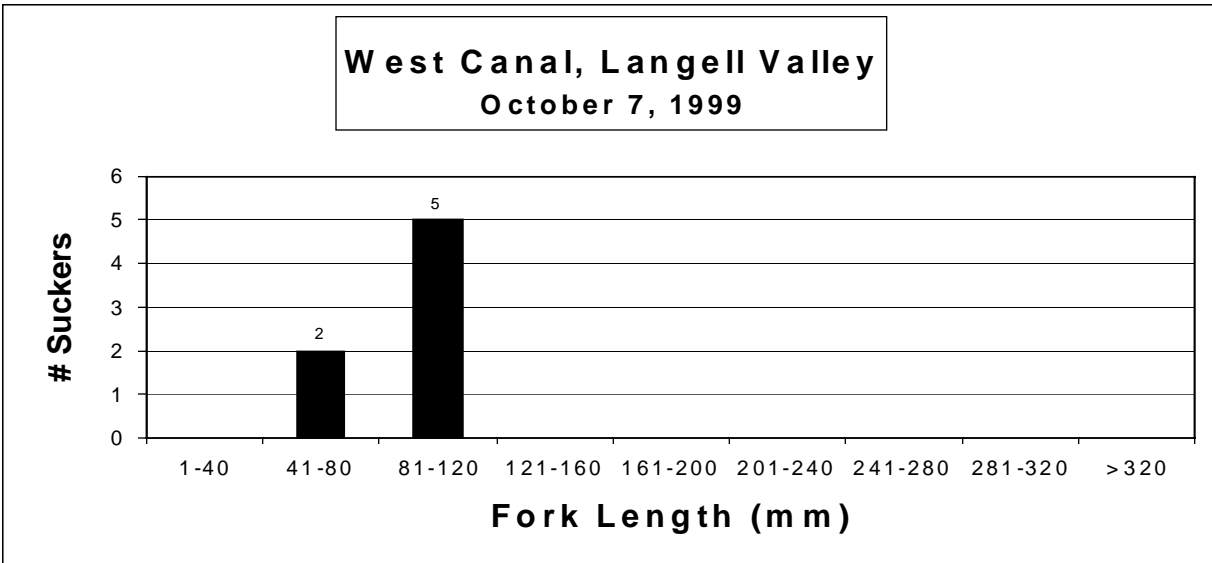


Figure 4. Length frequency of unknown suckers sampled from West Canal, Langell Valley, Oregon.

No suckers were found in this canal during fish sampling in 1991, the last time that sampling had occurred. Bullhead, perch, crappie, and sunfish (all unidentified to species) were reported at most sites (Reclamation, 1992).

The West Canal originates at the north end of Malone Reservoir, at the dam site. Water enters the reservoir during the irrigation season from controlled releases at Clear Lake Dam, approximately 10 miles upstream. At the end of the irrigation season, flow from Clear Lake is terminated and Malone Reservoir is drawn down over a period of several days. During draw down, water from the reservoir is diverted into the West Canal until the reservoir surface elevation is lower than the canal entrance, at which time the gates at Malone Dam are opened, allowing water to flow directly into the Lost River. A 1 1/4 inch avian wire mesh screen exists at the forebay of the West canal. However its poor condition in 1999 was ineffective at blocking juvenile and adult fish from entering the canal. It is unknown when most fish became entrained into the canal, either during the irrigation season or during draw down of the reservoir.

Clear Lake Dam Salvage

On October 1, fish salvage was conducted below the outlet of Clear Lake Dam within a few hours of shutting flow off. This salvage operation consisted of electrofishing the river channel from about 500 m downstream of the outlet tunnel of the dam to the tunnel entrance. This river reach was electrofished twice with two electrofishers. The reach consisted of pool and riffle areas ranging in depth from 0.1 m - 1.1 m. The 25 m long tunnel was not electrofished due to confined space safety concerns.

A total of 6 suckers (4 shortnose, 2 Lost River) were collected. Suckers ranged from 250 - 590 mm FL, with a mean of 398 mm, and median of 368 mm (Figure 5). All of the salvaged suckers were large juveniles or adults spanning several year classes (2+ and older). No young-of-the-year (1999 year class) or 1+ (1998 year class) were salvaged. The two Lost River suckers measured 535 mm and 590 mm FL.

Fish were found in the following order of abundance from higher to lower: Sacramento perch, blue chub, brown bullhead, pumpkinseed sunfish, sculpin, shortnose sucker, and Lost River sucker.

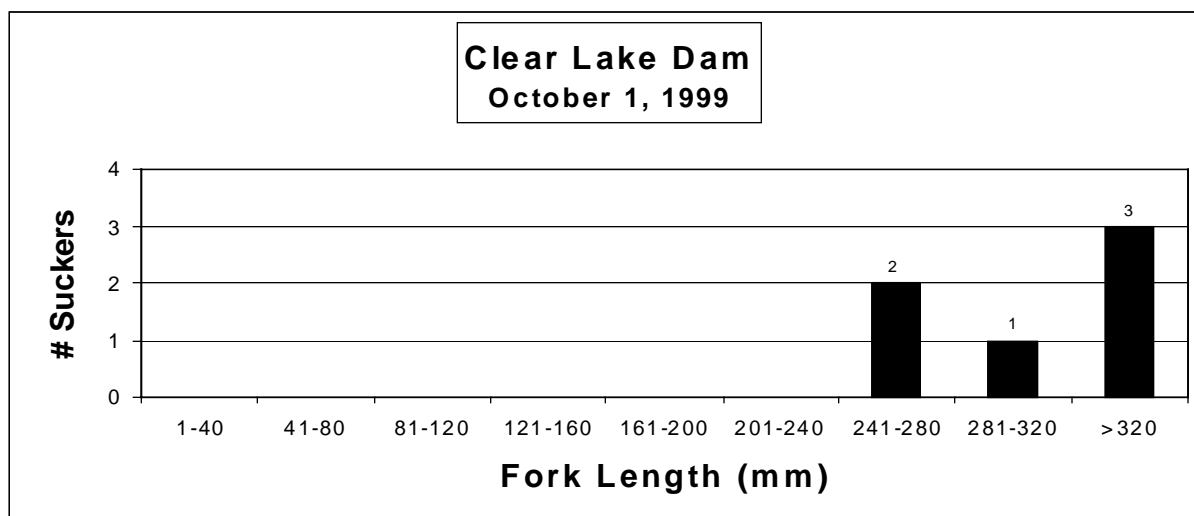


Figure 5. Length frequency of shortnose and Lost River suckers salvaged below Clear Lake Dam, California.

Reclamation installed a 76 m long by 9 m deep (tapering to 5 m at ends) net with 1.3 cm mesh (stretch measure) in the forebay area of the dam prior to the start of irrigation diversions. This net replaced the previous net measuring 75 m long by 5 m deep with 2.5 cm mesh (stretch measure) that had been in use since 1993. The net is intended to prevent larger suckers from leaving Clear Lake through the dam outlet and is maintained throughout the irrigation season. There is a possibility of fish being trapped in the area between the net and dam at time of deployment, swimming under or jumping over the net, or small fish swimming through the mesh.

The net, first used in 1993, appeared to reduce the number of adult suckers (>240 mm) being entrained. Salvage operations collected 253 in 1992, compared to one in 1993 (Table 1). This decrease may be due to differences in Clear Lake surface elevations. Very low elevations occurred during 1992, whereas higher elevations occurred in 1993. Numbers of adult suckers caught have increased slightly, from zero in 1994 to 14 in 1998. This increase may be due to variations in net conditions from year to year or from an increasing or aging downstream

Table 1. Suckers salvaged below Clear Lake Dam, California, 1991 - 1999.

Date	Total	Fork Length (mm)							Release Site
		1-40	41-80	81-120	121-160	161-200	201-240	>240	
09/17/91	256	0	0	0	2	90	25	139	Crystal Lake Hat., CA & Dexter Hat., NM
07/01/92	354	0	0	0	1	22	35	253	Lost River, Malone Reservoir, OR
09/30/93	55	0	5	2	0	0	0	1	Anderson-Rose Dam, Tule Lake, CA
09/20/94	292	0	0	26	54	3	2	0	English Channel, Tule Lake, CA
10/02/95	34	0	0	0	24	8	0	2	Lost River, Stevenson Park, OR
10/04/96	51	0	0	7	26	7	6	5	Lost River, Olene Gap, OR
03/11/97	10	0	0	1	0	0	0	9	Lost River, Olene Gap, OR
10/15/97	33	0	0	0	5	10	8	10	Lost River, Olene Gap, OR
10/08/98	24	0	0	0	1	1	8	14	Lost River, Stevenson Park, OR
10/01/99	6	0	0	0	0	0	0	6	Lost River, Stevenson Park, OR

population of suckers attracted to the outflow of the dam. Also, in 1997 and 1998 there were releases made in winter and spring during times when the net was not in place. In 1999 the number of adult suckers caught decreased to six. This may be a result of increased effectiveness of the deeper and smaller mesh block net, or may be due to unidentified variables.

One PIT tag was detected in a male Lost River sucker (FL 535 mm) salvaged below Clear Lake Dam in October, 1999. This sucker was originally tagged on March 30, 1999 during a sampling effort below Clear Lake Dam. This sampling effort occurred on March 29 and 30, immediately after flows from Clear Lake Dam were temporarily reduced from 850 cfs to 0 cfs for a safety of dams inspection. A total of 19 suckers (17 shortnose, 2 Lost River) were sampled, PIT tagged, and released back into the reach immediately below the dam. Four suckers were captured using trammel nets set in the Lost River channel, while 15 suckers were captured using dip nets from pooled areas in the meadow adjacent to the Lost River. These areas had become isolated from the Lost River when flow from Clear Lake Dam was rapidly decreased. An additional eight shortnose suckers were found dead in these isolated pooled areas. Four suckers captured alive from the pooled areas were in poor condition with abrasions, lesions and/or puncture wounds. Only one sucker released and PIT tagged in March was recaptured in October. The other 18 suckers may have moved downstream into the Lost River canyon, perished, or evaded capture during the October salvage effort. Reclamation biologists have recommended that future flow reductions be ramped down at a rate to allow suckers access to permanent water.

Link River Dam Salvage

Fish salvage operations were conducted below Link River Dam on October 18 and 19 in conjunction with a safety of dams inspection. A total of 44 suckers (7 shortnose, 4 Klamath largescale, 33 unknown) were collected and relocated to the Link River. Suckers ranged from 69 - 183 mm, with a mean of 125 mm, and median of 136 mm (Figure 6).

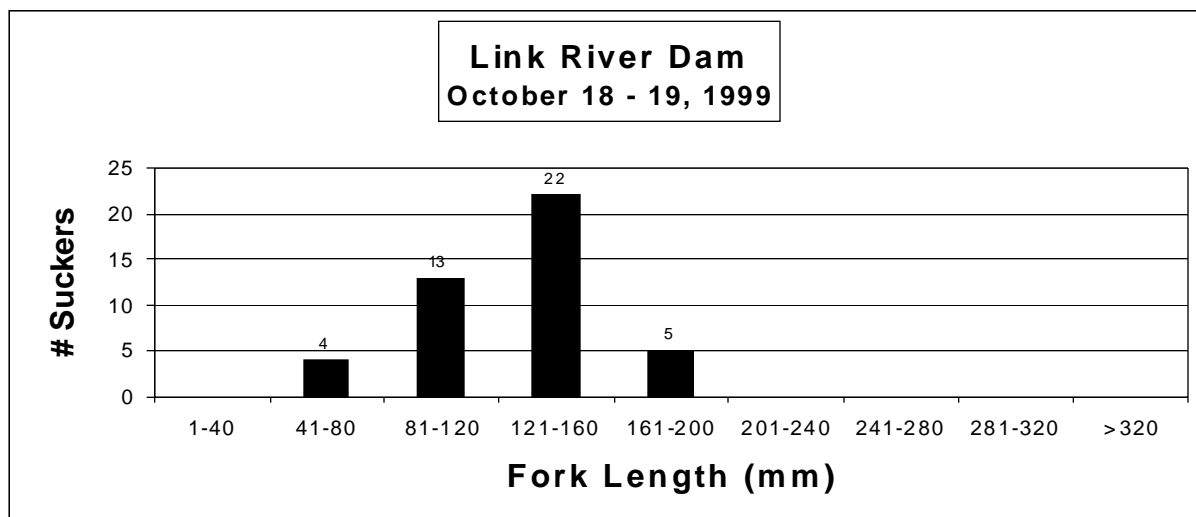


Figure 6. Length frequency of suckers salvaged at Link River Dam, Oregon.

Klamath Irrigation District Salvage

Salvage operations began within Klamath Irrigation District (KID) canals on October 18 and continued intermittently for 19 days until November 12 (Appendix 2). Fifty-six different sites were salvaged with several being revisited two or more times (Figure 10 & Appendix 1). A total of 23,806 suckers (219 shortnose, 29 Lost River, 277 Klamath largescale, 23,281 unknown) were salvaged ranging in size from 44 - 447 mm (Figure 7). Four-hundred-twenty-five adults (>240 mm) were captured, representing the largest number since salvage began. All but one of the adults were captured from the A-Canal at sites 1, 2, 2A, 3, 4 and 5 (Appendix 2). One adult sucker was captured at site 16 in the C-canal.

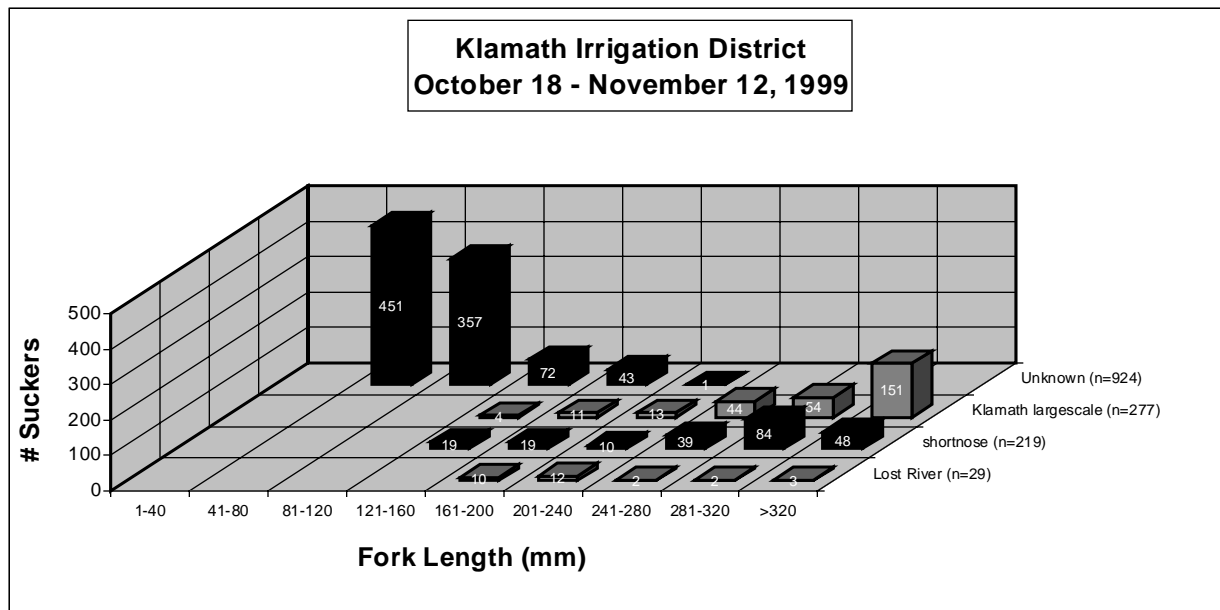


Figure 7. Length frequency of suckers (all species) salvaged in Klamath Irrigation District, Oregon.

The dominant age class in 1999 were juveniles (0+, <120 mm), comprising 55% of all measured suckers from KID (Table 2 & Figure 7). However, thousands of juvenile suckers were not measured to fork length and it is estimated that 97% of all suckers caught from KID were juveniles.

Figure 7 shows length frequencies for unknown, Klamath largescale, shortnose and Lost River suckers. All suckers <120 mm were not identified. Unknown suckers dominated the 41 - 80 mm, 81 - 120 mm, and 121 - 160 mm size classes. Klamath largescale suckers dominated the >320 mm size class. The highest number of shortnose suckers occurred in the 281 - 320 mm size class with 84 individuals measured. Lost River suckers were most abundant in the 201 - 240 mm size class with 12 individuals measured.

A total of 27 redband trout were collected of which 26 were measured (Figure 8). Trout ranged from 79 - 555 mm FL, with a mean of 267 mm, and median of 238 mm.

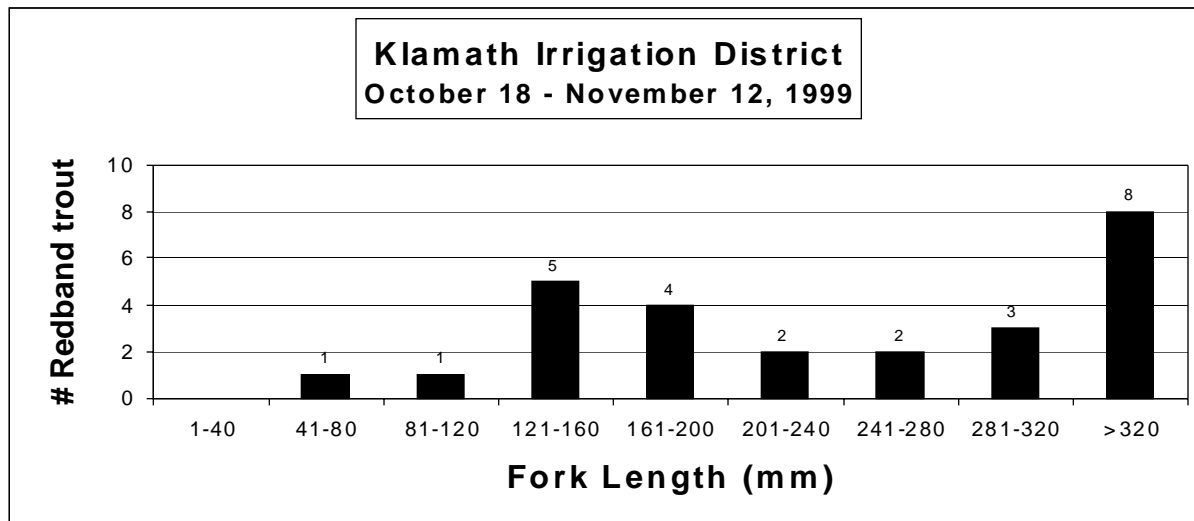


Figure 8. Length frequency of redband trout salvaged in Klamath Irrigation District, Oregon.

Relative abundance of salvaged suckers from 1994 to 1999 is shown in Figure 9. Abundance of Klamath largescale suckers has increased from a low of 6% in 1994 to a high of 78% in 1996, but has since declined to 50% in 1999. Inversely, abundance of shortnose suckers has decreased from a high of 78% in 1994 to a low of 20% in 1996, but has since increased to 40% in 1999. Lost River sucker abundance has ranged from a high of 15% in 1994 to a low of 2% in 1996 and 1998. Redband trout abundance has ranged from 0% in 1996 and 1998 to a high of 5% in 1999.

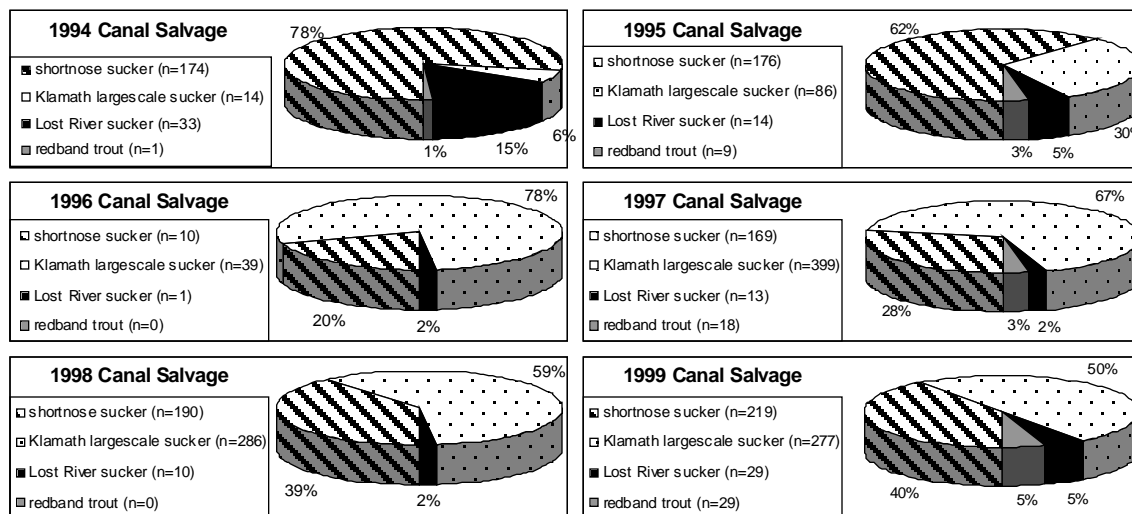


Figure 9. Species composition of identified suckers and trout salvaged from the Klamath Irrigation District, 1994 - 1999.



Figure 10. Canal salvage sites in Klamath and Tulelake Irrigation Districts, 1999.

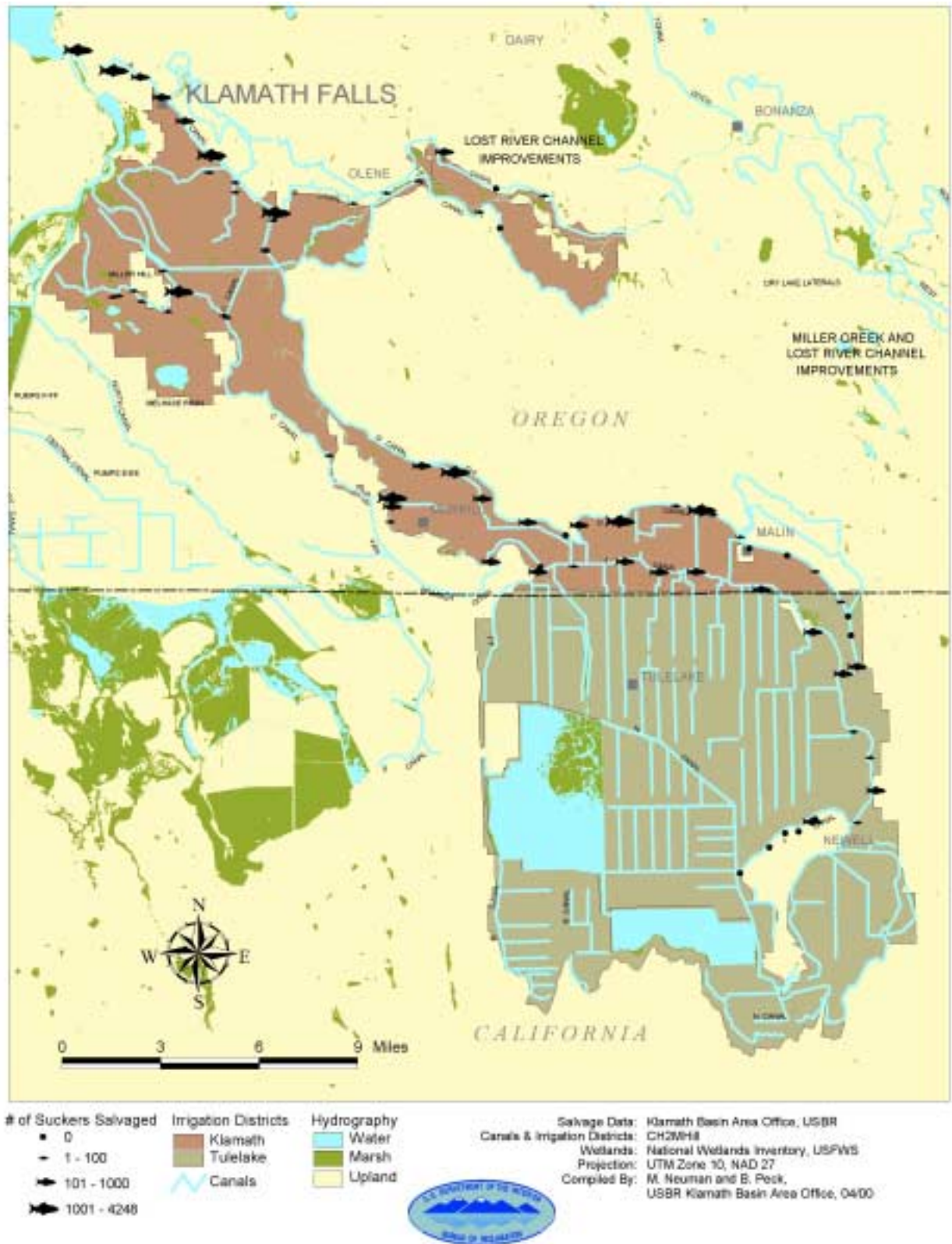


Figure 11. Distribution and abundance of suckers salvaged from Klamath and Tulelake Irrigation District canals, 1999.

Table 2. Annual sucker salvage totals from Klamath and Tulelake Irrigation Districts.

Year	Salvage total (KID + TID)	Dominant age class		Suckers >240 mm	Recorded sucker mortalities (#)	Percent mortality (%)
		0+	1+			
1991	3,236	x		24	-	-
1992	2,612		x	26	-	-
1993	788	x		26	-	-
1994	218		x	1	-	-
1995	3,935	x		29	-	-
1996	11,166	x		74	-	-
1997	2,383		x	378	82	3.4
1998	2,717	x		237	35	1.3
1999	26,928	x		425	64	0.2

Two salvaged suckers had previously been implanted with a PIT tag. One male Lost River sucker (FL 447 mm) was recaptured from site 16 in the C-Canal on October 28, 1999. This sucker was previously captured and PIT tagged in Agency Lake at Wood River mouth on May 11, 1999 by the Biological Resources Division of the U.S. Geological Survey. One female Klamath largescale sucker (FL 412 mm) was recaptured from site 1 in the A-Canal on November 4, 1999. This sucker was previously captured and PIT tagged during salvage at site 2 in the A-Canal on November 3, 1997 and had been released into Upper Klamath Lake at Barkley Springs.

Species occurred in the following order of abundance from higher to lower: blue chub, fathead minnow, unknown sucker, tui chub, yellow perch, sculpin, Klamath largescale sucker, speckled dace, shortnose sucker, goldfish (*Carassius auratus*), pumpkinseed sunfish, Lost River sucker, redband trout, and lamprey.

In 1999, a total of 5,908 suckers were found at the eight sites required to be salvaged by the BO (Table 3). This represents the largest total number of salvaged suckers since salvage began. Four sites contained over 1,000 suckers, with the greatest number salvaged from site 1 on the A-canal.

Table 3. Suckers found at eight sites required to be salvaged by the July 22, 1992 Biological Opinion.

Location	Site	1991	1992	1993	1994	1995	1996	1997	1998	1999
A-Canal headworks and tunnel	1	2,247	2,611	196	37	277	3,847	456	377	1,757
C-Canal Drop	14	207	2	0	0	280	0	0	485*	1,284
B-Canal area	11	259	0	0	21	0	204	5	8	46
Upper C-Canal	16	110	5	0	3	12	4	0	1	41
G-Drop	50	162	4	0	1	41	-	2	0	1
D-3 lateral	20	44	0	488	0	3	24	0	5	1,143
C-4 lateral	23	31	4	39	0	421	3	15	117	1,422
J-Canal - check 8	60	106	0	0	0	347	20	2	3	214
Total		3,166	2,626	723	62	1,381	4,102	480	996	5,908

* includes suckers in fish kill (n=322), 163 suckers were recovered alive from site 14.

Classifying years (Table 3) into poor (poor Upper Klamath Lake water quality and/or low lake elevations) and good (good water quality and/or higher lake elevations) categories reveals possible patterns in distribution / abundance of suckers salvaged from the canal system. Poor years include 1991 (low elevation), 1992 (low elevation), 1994 (low elevation), 1996 (water quality, major fish kill), and 1997 (water quality, major fish kill). Good years include 1993, 1995 (minor fish kill late in the irrigation season), 1998, and 1999. During poor years, 84% of salvaged suckers were concentrated at site 1, near the headgates of the A-Canal. During good years, 29% of suckers were salvaged at site 1. This indicates that suckers remained or were able to survive at site 1 during poor years, while during good years suckers were able to distribute throughout the canal system. This may also indicate that larger (1+) fish may better be able to remain near the point of diversion. Larger (1+) suckers were dominant in poor years 1992, 1994, and 1997 (Table 2).

Tulelake Irrigation District Salvage

Salvage operations occurred within TID canals on November 22 and 23, 1999. A total of 20 sites were visited, with salvage occurring at 16 sites (Figure 10 and Appendix 1). Two sites at the end of the J-Canal (69 and 70) were too deep to salvage. However, fish in this lower section of the J-Canal have direct access to Tule Lake via the N-Canal. Sites 53 and 68 were dry and therefore were not salvaged.

A total of 3,122 unknown suckers were salvaged from 16 sites (Figure 11 & Appendix 2). Measured suckers (n=237) ranged from 46 - 183 mm FL, with a mean of 82 mm, and median of 80 mm (Figure 12). Young-of-the-year suckers (n=233) comprised 98% of the total, and 2% (n=4) were age 1+. One redband trout (130 mm FL) was salvaged and released into the Lost River. This is the first trout recorded during salvage in TID canals.

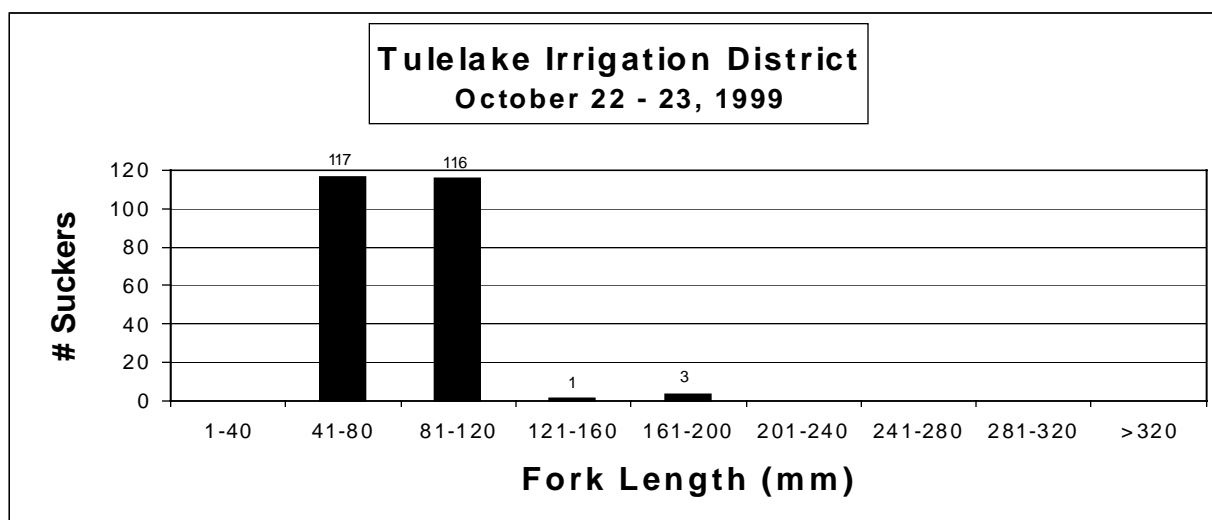


Figure 12. Length frequency of unknown suckers salvaged in Tulelake Irrigation District.

As many as ten fish species were encountered at most sites, occurring in the following order of abundance from higher to lower: fathead minnow, blue chub, tui chub, unknown sucker, yellow perch, goldfish, pumpkinseed sunfish, brown bullhead, and largemouth bass (*Micropterus salmoides*).

INCIDENTAL TAKE

The 1992 Biological Opinion allows up to 125 Lost River and shortnose suckers to be taken during salvage activities. No known sucker or trout mortalities occurred during the Clear Lake Dam, Link River Dam, TID, North Canal, and West Canal salvages. Sixty-one (0.3% of total) suckers (12 shortnose, 2 Lost River, 30 Klamath largescale, 17 unknown) and 8 redband trout (29.6% of total) died during KID salvage operations.

Stress on fish was minimized by frequently transferring fish in buckets from the salvage site to the transport truck. Multi-layered artificial slime and kiln dried salt (no additives, 5 ppt) were added to the holding tank to further reduce stress on transported fish. Artificial slime helps protect fish from bacterial infection while the salt equalizes osmotic pressure, reduces lactic acid production in the fish and can kill external parasites. A 4 ft section of PVC pipe, cut in half lengthwise, was used as a chute to carry fish from the tank directly to the release water.

REFERENCES

- United States Bureau of Reclamation. 1992. Salvage of suckers from the Klamath Project, dated January 7, 1992. U.S. Bureau of Reclamation, Klamath Falls, Oregon.
- United States Fish and Wildlife Service. 1992. Biological Opinion on the long term operation of the Klamath Project. 1-1-92-F-34. Region 1, Portland, Oregon.

Appendix 1. Klamath Project salvage site descriptions.

Site #	Canal/ River	Location	Road	Check #	Site	Canal/ # River	Location	Road
1	A	Headworks inlet & tunnel			51	J	Anderson-Rose Dam	
2	A	Tunnel outlet to KUHS area			52	J	Check 1	
2A	A	1/4 mile upstream of bridge	Main		53	J1	South end of siphon	
3	A	YMCA (1/4 mile stretch downstream and under bridge)			54	J	Check 2	
4	A	KFC (1/4 mile stretch downstream and under bridge)	S. 6th		55	J	Check 3	
5	A	1/4 mile stretch downstream and under bridge	Homedale		56	J	Check 4	
6	A3	Rd. up to headworks	Villa		57	J	Check 5	
7	A3	West of Rd.	Homedale		58	J	Check 6 (south of Rd.)	Stateline
8	A	Tail-end, above C-drop			59	J	Check 7	
9	A4	A-canal detention basin- north end			60	J	Check 8 (D&J canal confluence)	County Rd.
10	A4	A-canal detention basin- south end			61	J	Check 9	
11	B	Below check	Reeder		62	J	Check 10	
12	B	1/2 mile west of Olene (near wooden bridge)			63	J	Check 11	
13	B	Olene Flume (north end)			64	J	Check 12	
14	C	C-drop (Cell Tech)			65	J	Check 13	
15	C	Pool downstream of Cell Tech harvest screens			66	J	Culvert (east of Hwy)	Hwy 139
16	C	Above G-canal drop			67	J	RR bridge (west of Hwy)	Hwy 139
17	C	C4 confluence [ditchtender (Rocky's) house]			68	J	Check 14 (normally drained)	
18	C4	C-canal confluence (west side)			69	J	Culvert @ Rd.	County Rd.
19	C	Check 1/2 mi. South of bridge	Chin	C51097	70	J	Pump 24 (tailend of J-canal)	
20	D3	Adam's Flume area (east lat.)	Anderson		90	Link	Immediately downstream of Link River Dam	
21	D1	Adam's Flume area (south lat.)	Anderson		100	Lost	Downstream of Clear Lake Dam to head of canyon	
21A	D1	South lateral - 1/4 mile below site 21		C6103	120	North	Headgate to Farrington's check	
22	C4	Miller Hill pumping plant			120A	West	Headgate to Kents	
23	C4	Mac check	Spring Lake	C44027	120B	West	From bridge through Kents	
24	C4	Check 1/4 mi. south of Rd.	Old Midland	C44037	120C	West	From Kents through R. Smiths downstream	
25	C4	Check 1/4 mile north of Rd.	Old Midland	C44049	120D	West	From R. Smiths downstream to Farrington's check	
26	C4	Check 1/8 mile west of Rd. (before wooden br.)	Tingley	C44063	121	North	Farrington's check to driveway	
26b	C4	Check 1/4 mile west of Rd. (after wooden br.)	Tingley	C44066.5	121A	North	Farrington's check - downstream pool	
26c	C4	Check 1/4 mile east of Rd.	Tingley	C44057	122	North	Driveway to Gerber Rd	
27	D	D&G-canal area	Hill		123	North	Gerber Rd to Randall's check	
28	D	Check 2		C61010	124	North	Randall's check to Wood flume	
29	D	Check 3		C61016	125	North	Downstream of Wood flume	
30	D	Check 4	Dodd's Hollow	C61029	126	West	Malone Dam to 1st crossing @ W. Langell Valley	
31	D	Check 5 (Adam's)		C61041	127	West	1st crossing to 2nd W. Langell Valley Rd crossing	
32	D	Check 6 (above Rd.)	Payger	C61049	128	West	2nd W. Langell Valley Rd crossing to 1st check	
33	D	Check 7		C71060	129	West	1st check to 2nd check (Hammerich)	
34	D	Check 8 (behind locked gate, west of Rd.)	Harpold	C71077	130	West	2nd check to 3rd check (Biaggi)	
35	D	Tunnel bridge	Micha		131	West	3rd check to 3rd W. Langell Valley Rd crossing	
36	D	Check 9 (below SVID pumps)		C71087	132	West	3rd W. Langell Valley Rd crossing to 4th check	
37	D	Check 10		C71093	133	West	4th check to 5th check (Steel)	
38	D	Check 11 (Malin)			134	West	5th check to Cheese Factory Rd	
39	D	Check 12		C71108	135	West	Pine check to W. Langell Valley Road	
40	D	Check 13		C71113				
41	D	Check 14 (above Rd.)	Stateline	C71121				
42	D	Check 15 (below Rd.)	Stateline	C71129				
43	D	House with stone wall		C71132				
44	D	Driveway @ bull pasture, just before canal turns west		C71135				
45	E	1st crossing	North Poe Valley					
46	E	2nd crossing	North Poe Valley					
47	E	Crossing near dairy	North Poe Valley					
47b	E	1/4 mile south on Lost River Ranch, thru gate	North Poe Valley					
48	F	1 mi. east of Olene flume NW of blue house	South Poe Valley	C85				
48b	F	1/2 mi. east on road to Lost River pumping plant	South Poe Valley	C815				
49	F	SW of Reiling Rd. crossing thru metal gate	South Poe Valley	C827				
50	G	G-drop @ C-canal						

Appendix 2. Klamath and Tulelake Irrigation District salvage data, 1999.

Date	Site #	Canal	#	1-40	41-80	81-120	121-160	161-200	201-240	241-280	281-320	>320	Deep	Dry	Effort
10/18/99	9	A4	15		5	10									343
10/18/99	10	A4	77		5	15									519
10/19/99	6	A3	93		3	18									2449
10/19/99	7	A3	38		9	11									721
10/19/99	18	C4	8		5	3									>329
10/19/99	20	D3	238		17	3									678
10/19/99	21	D1	102		16	4									<238
10/20/99	20	D3	184				1								771
10/20/99	21	D1	46												365
10/20/99	23	C4	557		14	8	3	1							692
10/21/99	11	B	30		15	5									325
10/21/99	20	D3	252		7	2									961
10/21/99	21	D1	29		1										293
10/21/99	22	C4	1		1										199
10/21/99	23	C4	149		3		1								531
10/21/99	27	D	534		15	9	1	1							1110
10/21/99	21A	D1	28		20										265
10/22/99	20	D3	414												2239
10/22/99	23	C4	360												1386
10/22/99	45	E	299		9	14	3								503
10/25/99	8	A	53		3	16	2								>297
10/25/99	23	C4	292					1							>1812
10/25/99	25	C4	92		10	10									882
10/25/99	26	C4	1			1									288
10/25/99	26b	C4	11		7	4									416
10/25/99	26c	C4	69		2	18									749
10/26/99	8	A	15												776
10/26/99	11	B	16												304
10/26/99	12	B	70		13	7									954
10/26/99	13	B	30		15	5									240
10/26/99	20	D3	55												247
10/26/99	23	C4	64												715
10/26/99	24	C4	0												133
10/26/99	25	C4	6												361
10/26/99	27	D	451												1432
10/26/99	45	E	356					1							836
10/26/99	46	E												Y	
10/26/99	47	E	56		4	16									428
10/26/99	48	F	77		16	4									580
10/26/99	49	F	0												861
10/26/99	26c	C4	7												268
10/26/99	47B	E	1		1										56
10/26/99	48B	F	1		1										290
10/27/99	14	C	1284		4	21	10	11	1						
10/27/99	15	C	0												
10/28/99	12	B	6												557
10/28/99	16	C	1									1			<1206
10/28/99	17	C	49		13	8									
10/28/99	19	C	88		19	3									
10/28/99	27	D	10												<1206
10/28/99	45	E	73												184
10/28/99	50	G	1		1										380
10/29/99	2	A	434				52	49	13	6	10	18			
10/29/99	8	A	49				3								1028
11/01/99	3	A	115			15	3	1	1			1			2118
11/01/99	4	A	291		2	13	2	3	3	7	3	1			2004
11/01/99	5	A	1035		9	23	5	5	1		1	1			<8048
11/02/99	2	A	1927		1	9			2	19	28	47			14699
11/03/99	1	A	684		3	7	7	3	1	4	5	7			5948
11/03/99	8	A	39												1098
11/03/99	15	C	3												396
11/03/99	16	C	40						2		1				1455
11/04/99	1	A	868		1	4	1	1	7	27	41	43			13912
11/05/99	34	D	80		13	7									488
11/05/99	35	D	1138		14	6									1299
11/05/99	36	D	27		20										433
11/05/99	37	D	28		18	2									244
11/05/99	38	D												Y	0
11/05/99	39	D	0												77
11/05/99	40	D	3		2	1									122
11/05/99	41	D	3		2	1									109
11/05/99	42	D	0												38
11/05/99	43	D	0												93
11/05/99	44	D	208		7	13									398
11/08/99	30	D	685		17	3									868
11/08/99	31	D	0												68
11/08/99	32	D	474		17	3									889
11/08/99	33	D	1037		14	6									1374
11/08/99	35	D	1921												2192

11/09/99	1	A	205						2	10	9	10			>2839
11/09/99	3	A	73												1410
11/09/99	5	A	229												2137
11/09/99	24	C4	14		6	8									518
11/09/99	28	D	753		19	1									
11/09/99	29	D	320		16	4									1316
11/09/99	30	D	205												1513
11/09/99	32	D	259												1394
11/09/99	33	D	587												2434
11/09/99	35	D	757												2685
11/10/99	2	A	579					1		2	1	4			11351
11/10/99	4	A	180					3	2		1	1			2405
11/10/99	2A	A	40		4	9		1	1	4	19	23			
11/12/99	28	D	738												2320
11/12/99	29	D	233												1344
11/12/99	33	D	353												1200
11/12/99	35	D	432												1776
11/12/99	2A	A	71					1		6	19	45			1854
KID Total			23806		439	350	94	83	36	85	138	202			

Date	Site #	Canal	#	1-40	41-80	81-120	121-160	161-200	201-240	241-280	281-320	>320	Deep	Dry	Effort
11/22/99	57	J	380		12	8									949
11/22/99	58	J	410		8	11		1							<1747
11/22/99	59	J	246		14	6									>526
11/22/99	60	J	214		16	5									1152
11/22/99	61	J	3		2	1									308
11/22/99	62	J	9		4	5									290
11/22/99	63	J	101		11	8		1							766
11/22/99	64	J	8		4	4									208
11/22/99	65	J	0												129
11/22/99	66	J	144		4	16									739
11/22/99	67	J													136
11/22/99	68	J												Y	
11/22/99	69	J											Y		
11/22/99	70	J											Y		
11/23/99	51	J	228		10	8	1	1							1400
11/23/99	52	J	356		8	12									870
11/23/99	53	J1												Y	
11/23/99	54	J	25		13	7									466
11/23/99	55	J	326		8	12									1111
11/23/99	56	J	672		7	13									1318
TID Total			3122		121	116	1	3							

Appendix 2. Klamath and Tulelake Irrigation District salvage data, 1999 (continued).

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